

CLAIMS

What is claimed is:

1. A data compressing device which segments a data string including at least one unit of data into blocks forming vectors, searches a code book prepared in advance for a code vector similar to a vector extracted from a compression target, and outputs a code corresponding to the code vector, characterized in that

the block forming the vector is a line block in which data positions are one-dimensionally arrayed.

2. A data compressing device which segments a data string including at least one unit of data into blocks forming vectors, searches a code book prepared in advance for a code vector similar to a vector extracted from a compression target, and outputs a code corresponding to the code vector, characterized by comprising:

block shift means for extracting the block forming the vector of the compression target from the compression target while shifting a spatial position in a horizontal direction at least between blocks close to each other in a vertical direction.

3. A data compressing device according to claim 2, characterized in that the block forming the vector is a line block in which data positions are one-dimensionally arrayed.

4. A data expanding device which uses a data

string including at least one unit of data as a vector, searches a code book having at least one code vector for a code vector corresponding to a compression code, and allocates the code vector to a corresponding block position to reconstruct original data, characterized by comprising:

block shift means for allocating the block constructing the code vector searched from the code book while shifting a spatial position in a horizontal direction at least between blocks close to each other in a vertical direction.

5. A data expanding device according to claim 4, characterized in that the block forming the vector is a line block in which data positions are one-dimensionally arrayed.

6. A data compressing/expanding system which segments a data string including at least one unit of data into blocks forming vectors, in data compression, searches a code book prepared in advance for a code vector similar to a vector extracted from a compression target and outputs a code corresponding to the code vector, and in data expansion, searches the code book for a code vector corresponding to the code and allocates the code vector to a corresponding block position to reconstruct original data, characterized by comprising at least one of:

first block shift means for, in the data compression, extracting the block forming the vector

of the compression target from the compression target while shifting a spatial position in a horizontal direction at least between blocks close to each other in a vertical direction; and

second block shift means for, in the data expansion, allocating the block of the code vector searched from the code book while shifting the spatial position in the horizontal direction at least between the blocks close to each other in the vertical direction.

7. A data compressing/expanding system according to claim 6, characterized in that the block forming the vector is a line block in which data positions are one-dimensionally arrayed.

8. A data compressing/expanding system according to claim 66 or 7, characterized in that block shift by said first block shift means and block shift by said second block shift means have the same shift amount in opposite directions.

9. A data compressing device which segments a data string including at least one unit of data into blocks forming vectors, searches a code book prepared in advance for a code vector similar to a vector extracted from a compression target, and outputs a code corresponding to the code vector, characterized by comprising:

first vector quantizing means for, for data at each time in the compression target which changes

along a time axis, extracting blocks from the data, searching a first code book for a code vector similar to the vector, and outputting a code string corresponding to the code vector at each time; and

second vector quantizing means for rearranging code strings output by said first vector quantizing means at respective times to generate new vectors, and for each of the new vectors, searching a second code book for a code vector similar to the vector, and outputting a code string corresponding to the code vector.

10. A data compressing device according to claim 9, characterized by further comprising code string rearrangement means for, of the code strings output from said first vector quantizing means at each time, combining codes at a corresponding address between units of data at each time to generate new vectors.

11. A data compressing device which segments a data string including at least one unit of data into blocks forming vectors, searches a code book prepared in advance for a code vector similar to a vector extracted from a compression target, and outputs a code corresponding to the code vector, characterized by comprising:

first vector quantizing means for, for data at each time in the compression target which changes along a time axis, extracting blocks from the data, searching a first code book for a code vector similar

to the vector, and outputting a code string corresponding to the code vector at each time; and second vector quantizing means for defining, as a reference code string, a code string of data at a certain time in the code strings output from said first vector quantizing means at respective times, rearranging difference results each calculated for codes at a corresponding address between the reference code string and a code string of data at another time so as to generate new vectors, and for each of the new vectors, searching a second code book for a code vector similar to the vector, and outputting a code string corresponding to the code vector.

12. A data compressing device according to claim 11, characterized by further comprising code string rearrangement means for, of the code strings output from said first vector quantizing means at each time, defining the code string of the data at the certain time as the reference code string, calculating a difference for the codes at the corresponding address between the reference code string and the code string of the data at another time, and combining the differences at the corresponding address to generate new vectors.

13. A data compressing device which segments a data string including at least one unit of data into blocks forming vectors, searches a code book prepared

in advance for a code vector similar to a vector extracted from a compression target, and outputs a code corresponding to the code vector, characterized by comprising:

first vector quantizing means for, for data at each time in the compression target which changes along a time axis, extracting blocks from the data, searching a first code book for a code vector similar to the vector, and outputting a code string corresponding to the code vector at each time; and

second vector quantizing means for rearranging difference results each calculated for codes at a corresponding address in the code strings output from said first vector quantizing means at respective times between units of data adjacent in a time-axis direction so as to generate new vectors, and for each of the new vectors, searching a second code book for a code vector similar to the vector, and outputting a code string corresponding to the code vector.

14. A data compressing device according to claim 13, characterized by further comprising code string rearrangement means for, of the code strings output from said first vector quantizing means at each time, calculating a difference for the codes at the corresponding address between the units of data adjacent in the time-axis direction, and combining the differences at the corresponding address to generate new vectors.

15. A data expanding device which uses a data string including at least one unit of data as a vector, searches a code book having at least one code vector for a code vector corresponding to a compression code, and allocates the code vector to a corresponding block position to reconstruct original data, characterized by comprising:

second decoding means for searching the second code book for a code vector corresponding to a code string generated by said data compressing device of claim 9 or 10 and outputting the code vector; and

first decoding means for rearranging code strings each of which forms code vectors output from said second decoding means to generate new vectors, and for each of the new vectors, searching the first code book for a code vector corresponding to a code string which forms the new vector, and outputting the code vector.

16. A data expanding device which uses a data string including at least one unit of data as a vector, searches a code book having at least one code vector for a code vector corresponding to a compression code, and allocates the code vector to a corresponding block position to reconstruct original data, characterized by comprising:

second decoding means for searching the second code book for a code vector corresponding to a code string generated by said data compressing device of

claim 11 or 12 and outputting the code vector; and first decoding means for rearranging results of addition for codes at the corresponding address between a code string which forms code vectors output from said second decoding means and the reference code string to generate new vectors, and for each of the new vectors, searching the first code book for a code vector corresponding to a code string which forms the new vector, and outputting the code vector.

17. A data expanding device which uses a data string including at least one unit of data as a vector, searches a code book having at least one code vector for a code vector corresponding to a compression code, and allocates the code vector to a corresponding block position to reconstruct original data, characterized by comprising:

second decoding means for searching the second code book for a code vector corresponding to a code string generated by said data compressing device of claim 13 or 14 and outputting the code vector; and

first decoding means for, for the code string which forms code vectors output from said second decoding means, rearranging results of addition of codes in the order of addresses to generate new vectors, and for each of the new vectors, searching the first code book for a code vector corresponding to a code string which forms the new vector, and outputting the code vector.

18. A data compressing device according to any one of claims 9 to 14, characterized by further comprising time-axis shift means for, in generating the new vectors, arranging elements in the new vector while shifting the elements in the time-axis direction at least between vectors close to each other.

19. A data expanding device according to any one of claims 15 to 17, characterized by further comprising time-axis shift means for, in generating the new vectors, arranging at least elements close to each other in the new vector while shifting the elements in the time-axis direction.

20. A data compressing device which segments a data string including at least one unit of data into blocks forming vectors, searches a code book prepared in advance for a code vector similar to a vector extracted from a compression target, and outputs a code corresponding to the code vector, characterized by comprising:

vector quantizing means for, of data strings at times in the compression target which changes along a time axis, combining data at a corresponding address between units of data at the times to generate vectors, searching the code book for a code vector similar to each of the vectors, and outputting a code string corresponding to the code vectors.

21. A data compressing device according to claim

20, characterized by further comprising time-axis shift means for, in extracting the vectors, arranging elements in the vector while shifting the elements in the time-axis direction at least between vectors close to each other.

22. A data compressing device which segments a data string including at least one unit of data into blocks forming vectors, searches a code book prepared in advance for a code vector similar to a vector extracted from a compression target, and outputs a code corresponding to the code vector, characterized by comprising:

separation means for extracting at least one feature amount from the compression target and separating feature amount data from basic pattern data obtained by excluding the feature amount from the compression target,

wherein vector quantization is independently executed for each of the separated feature amount data and basic pattern data.

23. A data compressing device according to claim 22, characterized by further comprising first vector quantizing means for, for each basic pattern data separated at each time by said separation means from the compression target which changes along a time axis, extracting blocks from the data, searching a first code book of basic patterns for a code vector similar to the vector, and

outputting a code string corresponding to the vectors;

second vector quantizing means for rearranging the code strings output from said first vector quantizing means at respective times to generate new vectors, and for each of the new vectors, searching a second code book of basic patterns for a code vector similar to each of the vectors, and outputting a code string corresponding to the code vectors; and

third vector quantizing means for rearranging data strings each constructing a feature amount and separated by said separation means at each time from the compression target which changes along the time axis to generate new vectors, and for each of the new vectors, searching a third code book of feature amounts for a code vector similar to each of the vectors, and outputting a code string corresponding to the code vectors.

24. A data expanding device which uses a data string including at least one unit of data as a vector, searches a code book having at least one code vector for a code vector corresponding to a compression code, and allocates the code vector to a corresponding block position to reconstruct original data, characterized by comprising:

first decoding means for basic patterns, which reconstructs original basic pattern data on the basis of a code string related to a basic pattern output

from said data compressing device of claim 22 or 23; second decoding means for feature amounts, which reconstructs original feature amount data on the basis of a code string related to a feature amount output from said data compressing device of claim 22 or 23; and

synthesis means for synthesizing output results from said first and second decoding means to reconstruct the original data.

25. A data compressing device which segments a data string including at least one unit of data into blocks forming vectors, searches a code book prepared in advance for a code vector similar to a vector extracted from a compression target, and outputs a code corresponding to the code vector, characterized by comprising:

vector quantizing means for, for data at each time in the compression target which changes along a time axis, extracting blocks from the data, searching the code book for a code vector similar to each of the vectors, and outputting a code string corresponding to the code vectors at each time; and

output control means for, for the code string output from said vector quantizing means at each time, obtaining correlation between codes at a corresponding address between units of data adjacent in the time-axis direction and outputting the code only for an address where the correlation is smaller

than a predetermined value.

26. A data compressing device which segments a data string including at least one unit of data into blocks forming vectors, searches a code book prepared in advance for a code vector similar to a vector extracted from a color image as a compression target, and outputs a code corresponding to the code vector, characterized by comprising:

a code book for luminance signals and a code book for chrominance signals, said code book for luminance signals being assigned a larger number of code vectors than said code book for chrominance signals.

27. A data compressing device according to claim 26, characterized in that a compression rate of a Y signal as the luminance signal and U and V signals as the chrominance signals is 4 : 1 : 1 or 4 : 2 : 2.

28. A code book making method of making a code book which is formed from a set of vectors as data strings each including at least one unit of data and is to be used for vector quantization, in which vector quantization processing is repeatedly executed using certain sample data and an initial code book, and contents in a range designated on a virtual two-dimensional plane of the code book are updated in accordance with a predetermined update coefficient for every processing step so as to optimize the code book, characterized in that:

a code book of patterns each having a data value

continuously changing from a minimum value to a maximum value of possible values is used as the initial code book.

29. A code book making method of making a code book which is formed from a set of vectors as data strings each including at least one unit of data and is to be used for vector quantization, in which vector quantization processing is repeatedly executed using sample data and an initial code book, and contents in a range designated on a virtual two-dimensional plane of the code book are updated in accordance with a predetermined update coefficient for every processing step so as to optimize the code book, characterized in that:

the range to be updated by one processing step is one-dimensionally applied on the virtual two-dimensional plane and the range is reduced as the number of times of update increases.

30. A code book making method of making a code book which is formed from a set of vectors as data strings each including at least one unit of data and is to be used for vector quantization, in which vector quantization processing is repeatedly executed using sample data and an initial code book, and contents in a range designated on a virtual two-dimensional plane of the code book are updated in accordance with a predetermined update coefficient for every processing step so as to optimize the code

book, characterized in that:

an initial value of the update coefficient to one value is set within a range of 0.3 to 1 and the value of the update coefficient is reduced as the number of times of update increases.

31. A code book making method of making a code book which is formed from a set of vectors as data strings each including at least one unit of data and is to be used for vector quantization, in which vector quantization processing is repeatedly executed using sample data and an initial code book, and contents in a range designated on a virtual two-dimensional plane of the code book are updated in accordance with a predetermined update coefficient for every processing step so as to optimize the code book, characterized in that:

a code book of patterns each having a data value continuously changing from a minimum value to a maximum value of possible values is used as the initial code book;

the range to be updated by one processing step is one-dimensionally applied on the virtual two-dimensional plane and the range is reduced as the number of times of update increases; and

an initial value of the update coefficient to one value is set within a range of 0.3 to 1 and the value of the update coefficient is reduced as the number of times of update increases.

32. A code book making method of making a code book which is formed from a set of vectors as data strings each including at least one unit of data and is to be used for vector quantization, in which vector quantization processing is repeatedly executed using sample data and an initial code book, and contents in a range designated on a virtual two-dimensional plane of the code book are updated in accordance with a predetermined update coefficient for every processing step so as to optimize the code book, characterized in that:

the code book for units of sample data is independently optimized and code books obtained are synthesized to make a new code book.

33. A code book making method according to claim 32, characterized in that, in independently optimizing the code book for the units of sample data, the code book is made according to said method of any one of claims 28 to 31.

34. A data compressing device according to any one of claims 1 to 3, 9 to 14, 18, 20 and 21, and 25 to 27, characterized by further comprising:

feature amount storage means for storing a feature amount obtained in advance for each code vector in the code book;

feature amount calculating means for obtaining a feature amount of the vector extracted from the compression target; and

calculation omitting means for determining whether calculation for obtaining similarity between each of the code vectors and the compression target vector is to be omitted on the basis of the feature amount of each code vector, which is stored in said feature amount storage means, and the feature amount of the compression target vector.

35. A data compressing device according to claim 34, characterized in that the feature amount is a sum, an average value, or DC components of values of the data string constructing the vectors.

36. A data compressing device according to claim 34, characterized in that the feature amount is a sum, an average value, or DC components of values of some elements of the data string constructing the vectors after the values are operated and inverted with reference to an intermediate value of possible values.

37. A data compressing device according to claim 34, characterized in that the feature amount is a direction of change in a block of values of the data string constructing the vectors.

38. A data compressing device according to claim 34, characterized in that the feature amount is a form of change in a block of values of the data string constructing the vectors.

39. A data compressing device according to any one of claims 34 to 38, characterized in that said calculation omitting means comprises

absolute difference value calculating means for obtaining an absolute difference value between a feature amount of a certain code vector and the feature amount of the compression target vector, and

omission determining means for, when the absolute difference value obtained by said absolute difference value calculating means is larger than a minimum value of a value representing similarity, which is already obtained for another code vector, omitting similarity calculation for the certain code vector.

40. A data compressing device according to any one of claims 1 to 3, 9 to 14, 18, 20 and 21, and 25 to 27, characterized by further comprising:

feature amount storage means for storing feature amounts of different types, which are obtained in advance for each of the code vectors in the code book;

feature amount calculating means for obtaining the feature amounts of different types for each vector extracted from the compression target; and

calculation omission means for determining for each of the code vectors whether calculation for obtaining similarity to the compression target vector is to be omitted, on the basis of the feature amounts of different types for each code vector, which are stored in said feature amount storage means and the feature amounts of different types for the compression target vector, which are obtained by said

feature amount calculating means.

41. A data compressing/expanding system comprising a code book server for holding at least one code book, a data compressing system, and a data expanding system, characterized in that

said code book server supplies one of the held code books in accordance with a request from said data compressing system or said data expanding system.

42. A data compressing/expanding system according to claim 41, characterized in that said code book server comprises:

code book holding means for holding at least one code book;

code book making means for making a code book matching the request from said data compressing system or said data expanding system; and

code book management means for supplying the code book held in said code book holding means or the code book made by said code book making means in accordance with the request from said data compressing system or said data expanding system.

43. A data compressing method in which a data string including at least one unit of data is segmented into blocks forming vectors, a code vector similar to a vector extracted from a compression target is searched from a code book prepared in advance, and a code corresponding to the code vector is output, characterized in that

the block forming the vector is a line block in which data positions are one-dimensionally arrayed.

44. A data compressing method in which a data string including at least one unit of data is segmented into blocks forming vectors, a code vector similar to a vector extracted from a compression target is searched from a code book prepared in advance, and a code corresponding to the code vector is output, characterized in that:

the block forming the vector of the compression target is extracted from the compression target while shifting a spatial position in a horizontal direction at least between blocks close to each other in a vertical direction.

45. A data compressing method according to claim 44, characterized in that the block forming the vector is a line block in which data positions are one-dimensionally arrayed.

46. A data expanding method in which a data string including at least one unit of data is used as a vector, and a code vector corresponding to a compression code is searched from a code book having at least one code vector and allocated to a corresponding block position to reconstruct original data, characterized in that:

the block constructing the code vector searched from the code book is allocated while shifting a spatial position in a horizontal direction at least

between blocks close to each other in a vertical direction.

47. A data expanding method according to claim 46, characterized in that the block forming the vector is a line block in which data positions are one-dimensionally arrayed.

48. A data compressing/expanding method in which a data string including at least one unit of data is segmented into blocks forming vectors, in data compression, a code vector similar to a vector extracted from a compression target is searched from a code book prepared in advance, and a code corresponding to the code vector is output, and in data expansion, a code vector corresponding to the code is searched from the code book and allocated to a corresponding block position to reconstruct original data, characterized in that:

in the data compression, the block forming the vector of the compression target is extracted from the compression target while shifting a spatial position in a horizontal direction at least between blocks close to each other in a vertical direction; and

in the data expansion, the block of the code vector searched from the code book is allocated while shifting the spatial position in the horizontal direction at least between the blocks close to each other in the vertical direction so that the shift

amount becomes the same as in the data compression, and the direction is opposite to that in the data compression.

49. A data compressing/expanding method according to claim 48, characterized in that the block forming the vector is a line block in which data positions are one-dimensionally arrayed.

50. A data compressing method in which a data string including at least one unit of data is segmented into blocks forming vectors, a code vector similar to a vector extracted from a compression target is searched from a code book prepared in advance, and a code corresponding to the code vector is output, characterized by comprising:

the first vector quantizing step of, for data at each time in the compression target which changes along a time axis, extracting blocks from the data, searching a first code book for a code vector similar to the vector, and outputting a code string corresponding to the code vector at each time;

the code string rearrangement step of, of the code strings output in the first vector quantizing step at each time, combining codes at a corresponding address between units of data at each time to generate new vectors; and

the second vector quantizing step of, for each of the new vectors generated in the code string rearrangement step, searching a second code book for

a code vector similar to the vector, and outputting a code string corresponding to the code vector.

51. A data compressing method in which a data string including at least one unit of data is segmented into blocks forming vectors, a code vector similar to a vector extracted from a compression target is searched from a code book prepared in advance, and a code corresponding to the code vector is output, characterized by comprising:

the first vector quantizing step of, for data at each time in the compression target which changes along a time axis, extracting blocks from the data, searching a first code book for a code vector similar to the vector, and outputting a code string corresponding to the code vector at each time

the code string rearrangement step of, of the code strings output in the first vector quantizing step at each time, defining the code string of the data at the certain time as the reference code string, calculating a difference between the reference code string and the code string of the data at another time or between the codes at the corresponding address, and combining the differences at the corresponding address to generate new vectors; and

the second vector quantizing step of, for each of the new vectors generated in the code string rearrangement step, searching a second code book for a code vector similar to the vector, and outputting a

code string corresponding to the code vector.

52. A data compressing method in which a data string including at least one unit of data is segmented into blocks forming vectors, a code vector similar to a vector extracted from a compression target is searched from a code book prepared in advance, and a code corresponding to the code vector is output, characterized by comprising:

the first vector quantizing step of, for data at each time in the compression target which changes along a time axis, extracting blocks from the data, searching a first code book for a code vector similar to the vector, and outputting a code string corresponding to the code vector at each time;

code string rearrangement step of, of the code strings output in the first vector quantizing step at each time, calculating a difference between the units of data adjacent in the time-axis direction or between the codes at the corresponding address, and combining the differences at the corresponding address to generate new vectors; and

the second vector quantizing step of, for each of the new vectors generated in the code string rearrangement step, searching a second code book for a code vector similar to the vector, and outputting a code string corresponding to the code vector.

53. A data compressing method according to any one of claims 50 to 52, characterized in that the

code string rearrangement step comprises, in generating the new vectors, arranging elements in the new vector while shifting the elements in the time-axis direction at least between vectors close to each other.

54. A data compressing method in which a data string including at least one unit of data is segmented into blocks forming vectors, a code vector similar to a vector extracted from a compression target is searched from a code book prepared in advance, and a code corresponding to the code vector is output, characterized by comprising:

the vector quantizing step of, of data strings at times in the compression target which changes along a time axis, combining data at a corresponding address between units of data at the times to generate vectors, searching the code book for a code vector similar to each of the vectors, and outputting a code string corresponding to the code vectors.

55. A data compressing method according to claim 54, characterized in that, in extracting the vectors, elements in the vector are arranged while shifting the elements in the time-axis direction at least between vectors close to each other.

56. A data compressing method in which a data string including at least one unit of data is segmented into blocks forming vectors, a code vector similar to a vector extracted from a compression

target is searched from a code book prepared in advance, and a code corresponding to the code vector is output, characterized in that:

at least one feature amount is extracted from the compression target, feature amount data is separated from basic pattern data obtained by excluding the feature amount from the compression target, and vector quantization for each of the separated feature amount data and basic pattern data is independently executed.

57. A data compressing method in which a data string including at least one unit of data is segmented into blocks forming vectors, a code vector similar to a vector extracted from a compression target is searched from a code book prepared in advance, and a code corresponding to the code vector is output, characterized by comprising:

the vector quantizing step of, for data at each time in the compression target which changes along a time axis, extracting blocks from the data, searching the code book for a code vector similar to each of the vectors, and outputting a code string corresponding to the code vectors at each time; and

the output step of, for the code string output in the vector quantizing step at each time, obtaining correlation between codes at a corresponding address between units of data adjacent in the time-axis direction and outputting the code only for an address

where the correlation is smaller than a predetermined value.

58. A data compressing method in which a data string including at least one unit of data is segmented into blocks forming vectors, a code vector similar to a vector extracted from a compression target is searched from a code book prepared in advance, and a code corresponding to the code vector is output, characterized in that:

a code book for luminance signals and a code book for chrominance signals are prepared, said code book for luminance signals being assigned a larger number of code vectors than said code book for chrominance signals.

59. A data compressing method according to claim 58, characterized in that a compression rate of a Y signal as the luminance signal and U and V signals as the chrominance signals is 4 : 1 : 1 or 4 : 2 : 2.

60. A data compressing method according to any one of claims 43 to 45 and 50 to 59, characterized in that a feature amount extracted from the compression target is compared with a feature amount related to each code vector in the code book, and on the basis of a comparison result, calculation for obtaining similarity between the code vector and the compression target vector is omitted.

61. A data compressing method according to claim 60, characterized by further comprising:

the absolute difference value calculating step of obtaining an absolute difference value between a feature amount of a certain code vector and the feature amount of the compression target vector, and

the omission determining step of, when the absolute difference value obtained in the absolute difference value calculating step is larger than a minimum value of a value representing similarity, which is already obtained for another code vector, omitting similarity calculation for the certain code vector.

62. A data compressing method according to claim 60 or 61, characterized in that, using feature amounts of different types, it is determined for each of the code vectors whether calculation for obtaining similarity to the compression target vector is to be omitted, on the basis of the feature amounts of the above types and feature amounts of the types extracted for the compression target vector.

63. A data compressing/expanding method in a data compressing/expanding system comprising a code book server for holding at least one code book, a data compressing system, and a data expanding system, characterized in that

the code book server supplies one of the held code books in accordance with a request from the data compressing system or the data expanding system.

64. A computer-readable recording medium

characterized in that said recording medium records a program for causing a computer to realize the function of claim 1.

65. A computer-readable recording medium characterized in that said recording medium records a program for causing a computer to function as said means of any one of claims 2, 4, and 6.

66. A computer-readable recording medium characterized in that said recording medium records a program for causing a computer to function as said means of any one of claims 9 to 25.

67. A computer-readable recording medium characterized in that said recording medium records a program for causing a computer to execute a processing procedure of said code book making method of any one of claims 29 to 32.

68. A computer-readable recording medium characterized in that said recording medium records a program for causing a computer to function as said means of claim 34 or 40.

69. A computer-readable recording medium characterized in that said recording medium records a program for causing a computer to realize the function of claim 41.

70. A computer-readable recording medium characterized in that said recording medium records a program for causing a computer to execute the step of any one of claims 50 to 52, 54, and 57.